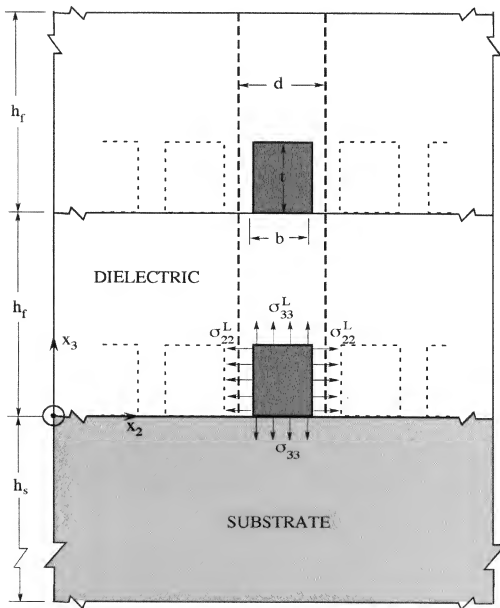
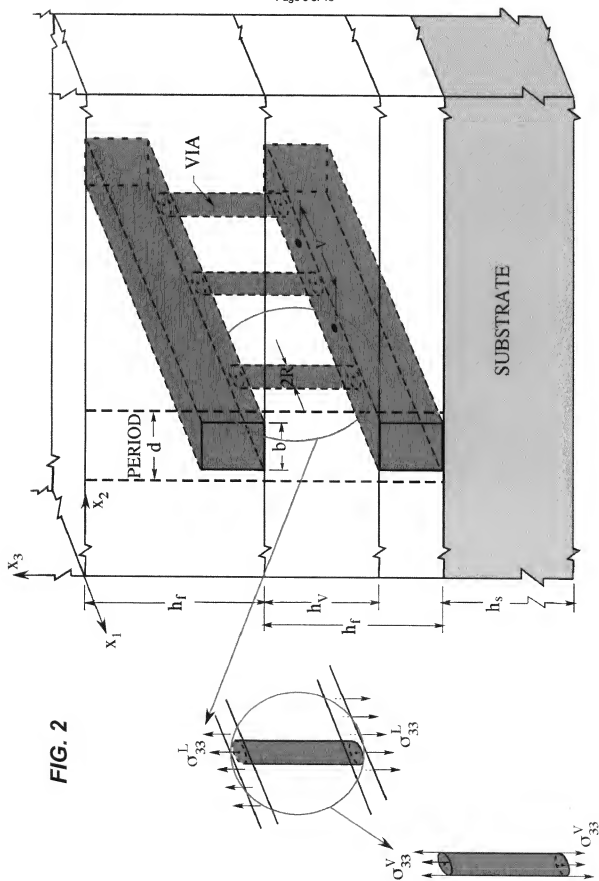


FIG. 1B





$E_{Cu} = 110 \text{ GPa}$, $\alpha_{Cu} = 17 \times 10^{-6}/^{\circ}\text{C}$ $E_{TEOS} = 59 \text{ GPa}$, $\alpha_{TEOS} = 1 \times 10^{-6}/^{\circ}\text{C}$
 $E_W = 410 \text{ GPa}$, $\alpha_W = 4.3 \times 10^{-6}/^{\circ}\text{C}$ $E_{SILK} = 2.45 \text{ GPa}$, $\alpha_{SILK} = 66 \times 10^{-6}/^{\circ}\text{C}$

FIG. 3

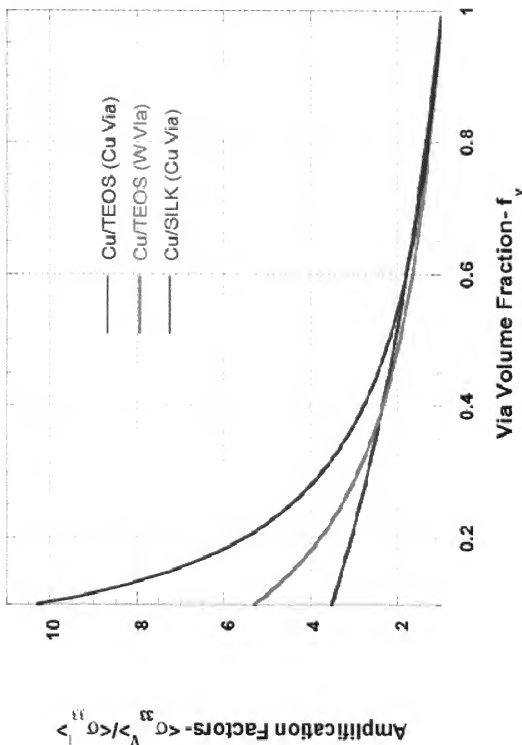
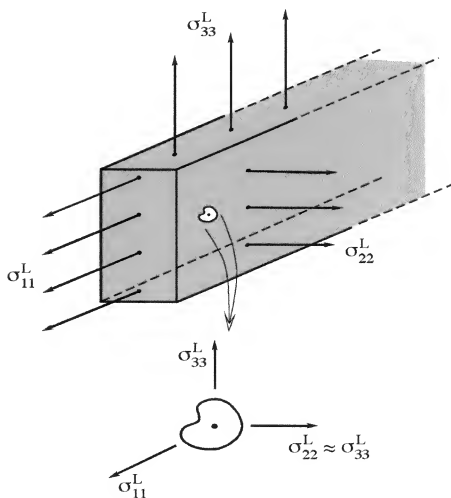


FIG. 4



Materials: Cu lines, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $b=0.4\mu\text{m}$, $f=b/d$
Criterion: $\alpha=2$ or 3 , $\sigma_y=293\text{MPa}$ (using Hall-Petch)

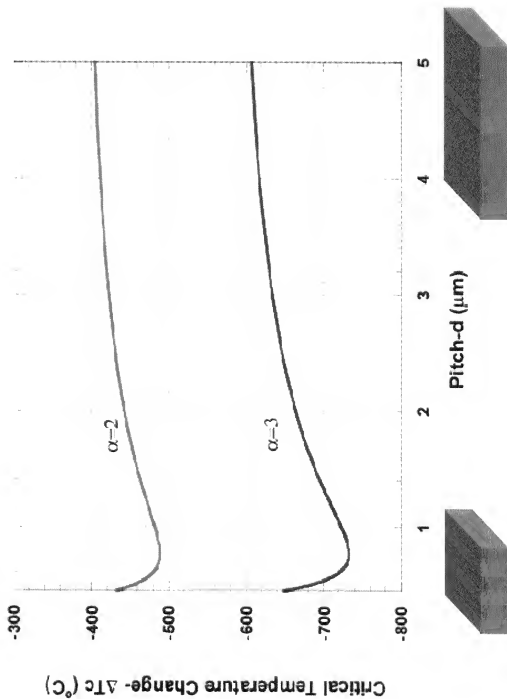
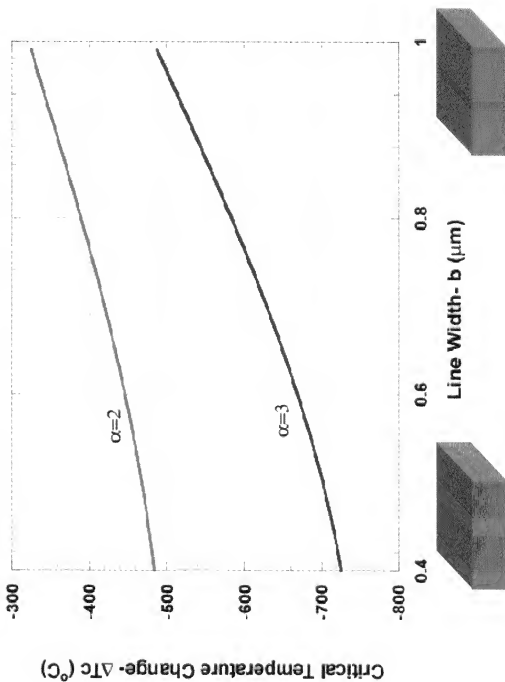


FIG. 5

Materials: Cu lines, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $d=1.0\mu\text{m}$, $f=b/d$
Criterion: $\alpha=2$ or 3 , $\sigma_y = 26.9[1 + 6.64\{(t+b)/2\}^{-0.5}]$ MPa

FIG. 6



Materials: Cu lines, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $b=0.4\mu\text{m}$, $f=b/d$
Criterion: $\alpha=2$ or 3 , $\sigma_y=293\text{MPa}$ (using Hall-Petch)

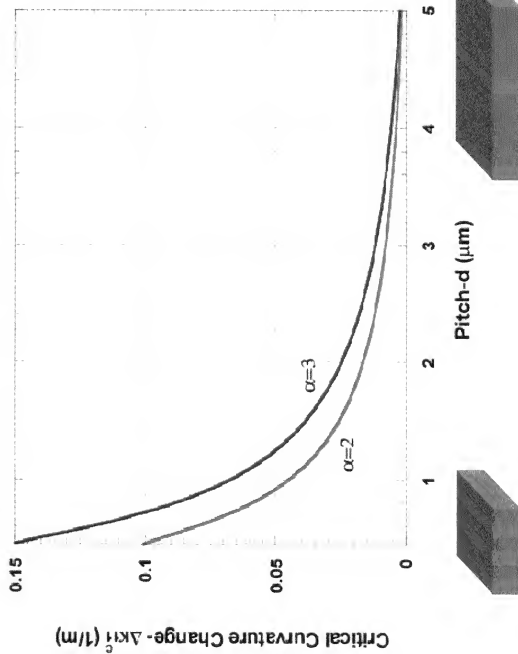
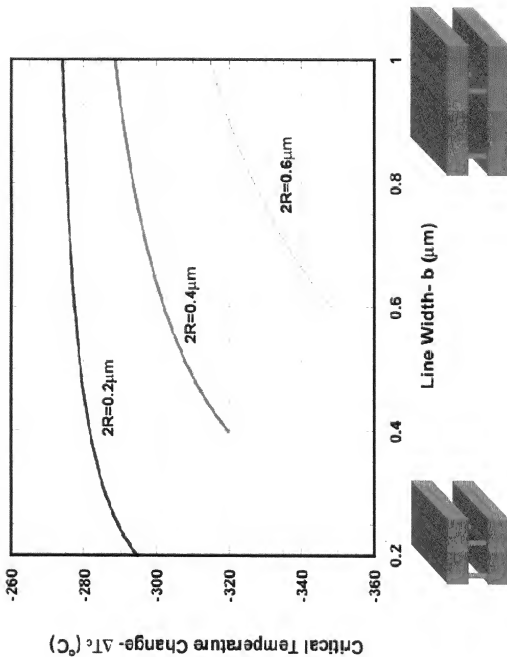


FIG. 7

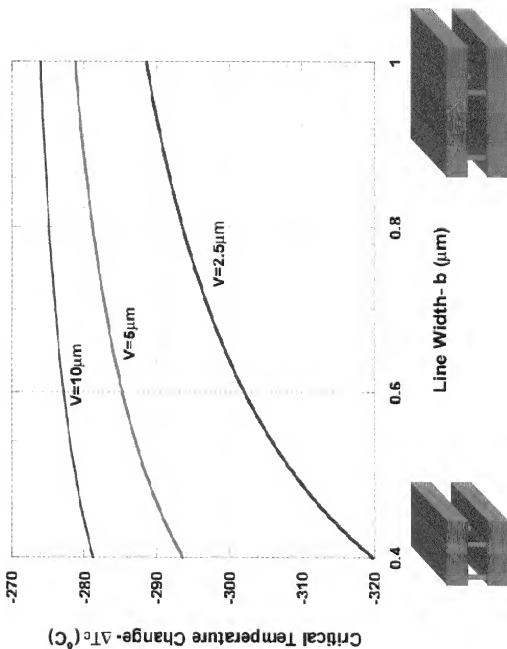
Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $f=b/d=0.5$, $V=2.5\mu\text{m}$, $f_v=\pi R^2/bV$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Half-Petch)

FIG. 8



Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $f=b/d=0.5$, $2R=0.4\mu\text{m}$, $f_v=\pi R^2/bV$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Hall-Petch)

FIG. 9



Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $f=b/d=0.5$, $V=2.5\mu\text{m}$, $f_v=\pi R^2/bV$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Hall-Petch)

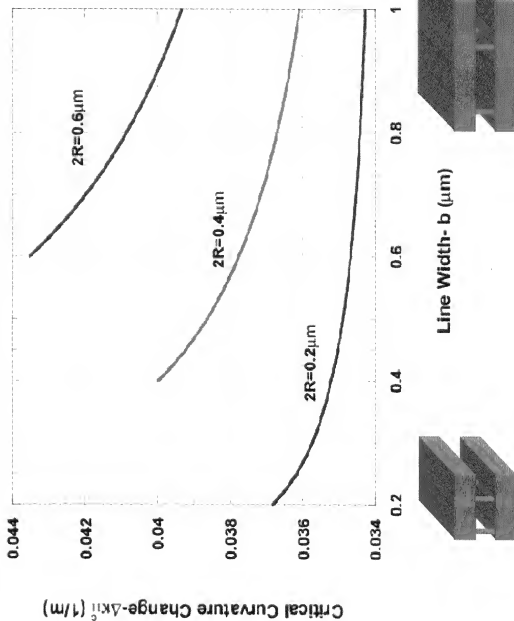


FIG. 10

Materials: Cu lines/vias, TEOS dielectric, Si Substrate
Geometry: $t=0.5\mu\text{m}$, $h_s=525\mu\text{m}$, $b=0.4\mu\text{m}$, $f=b/d$, $2R=0.4\mu\text{m}$, $V=2.5\mu\text{m}$, $f_v=\pi R^2/bV=0.125$
Criterion: $\alpha=3$, $\sigma_y=293\text{MPa}$ (using Hall-Petch)

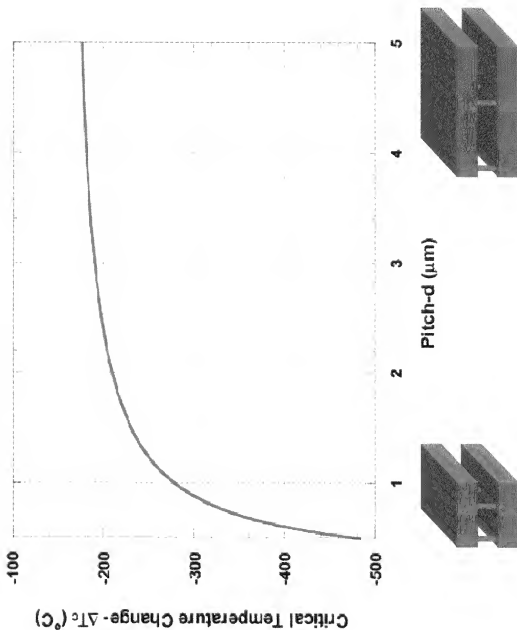


FIG. 11

FIG. 12

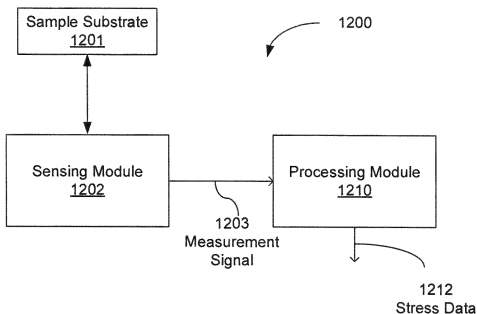


FIG. 13

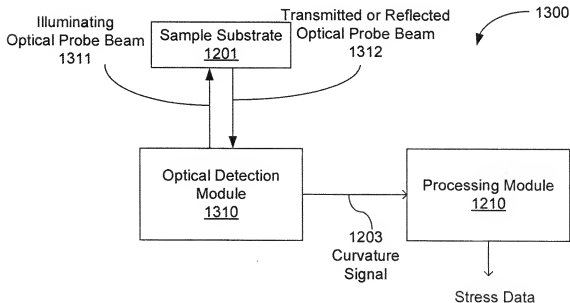


FIG. 14

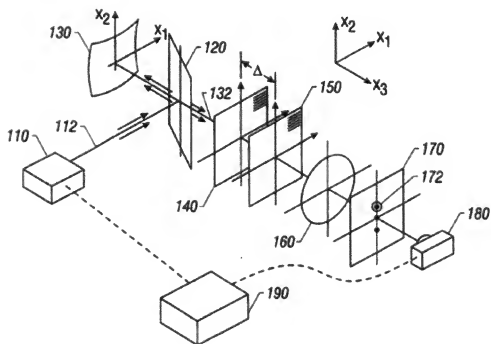


FIG. 15

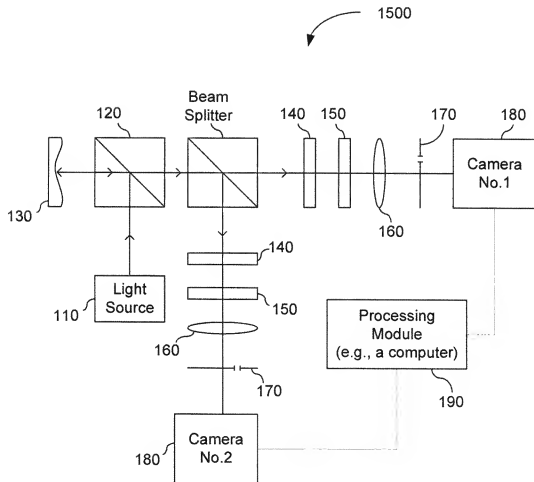


FIG. 16

